JLab Technical Note
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Indium Soldering of Anodized GaAs Photocathode Material

Procedure for attaching GaAs photocathodes to stainless steel stalks with Indium solder as used in the JLab polarized electron sources.

Supplies & Equipment Required

The following supplies are required. A small quantity of these supplies are kept in the photocathode preparation tool box located in the EEL Source Lab. All items used should be cleaned in accordance with the Glassware & Tool Cleaning Procedure detailed at the end of this section.

1) Powder-free gloves such as those suitable for use with UHV vacuum system components.

2) An inch long piece of Indium foil[1] part # 121721.

3) A cleaned and anodized photocathode[2].

4) Stainless steel stalk with heating element and thermocouple.

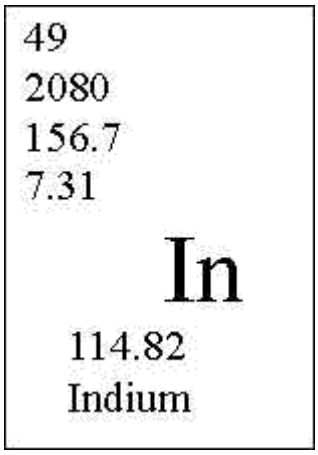
5) Pair of Tweezers.

6) Stalk holding fixture.

7) Glass cover slide and a weight (~40 grams).

8) Tantalum cup[3].

9) Stylus and crimping fixture.



Glassware & Tool Cleaning Procedure

Start with all new glassware & tools.
Ultrasonically clean each item three times using a solution of Alconox or Micro-Clean in de-ionized water.
Rinse each item out with methanol. Leach each item with boiling de-ionized water.
Cover with a sheet of lint free clean room paper and clean aluminum foil.

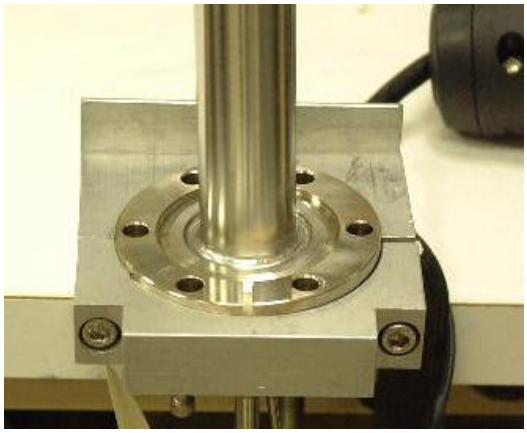
Please note that once a tool has been properly cleaned it may be reused several times if it is properly wrapped and stored between uses. A beaker may be reused if the same chemicals are used each time.

Preparations Before the Anodization Process

The following steps need to be completed before the start of the Indium soldering process:

10) Anodize a single side of a GaAs photocathode using procedures listed in the anodization tech note. Indium solder does not wet well to anodized surfaces so the back of the sample should not be anodized.

11) Securely mount a clean stalk in the stalk holding fixture. Pay particular attention to the levelness of the base. A base that



[1] Indium Corporation of America, 1676 Lincoln Avenue, Utica, NY 13503-0269, 800-4-INDIUM
IPN 121721, .500 x .002 Ribbon, Alloy 99.99 In

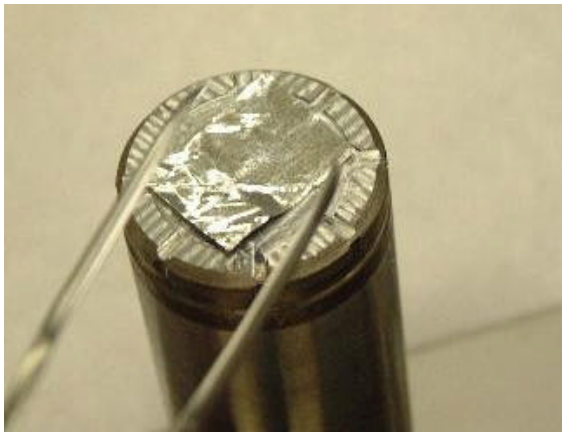
[2] "Active Area Definition of GaAs Photocathodes via Anodization Jlab" Technical Note
By P.M. Rutt & A.R. Day, JLAB-TN-01-030, 6/2701

[3] "The fabrication of Tantalum Cups for the Illinois/CEBAF Polarized Electron Source," by B.M. Dunham, L.S. Cardman, and C.K. Sinclair, NPL Tech note 90-8 (5/19/90 - revised 7/22/92)

is not level will result in uneven distribution of Indium solder and a photocathode that is not properly oriented to the stalk.

12) Connect the stalk heater and the Nitrogen purge line to the stalk.

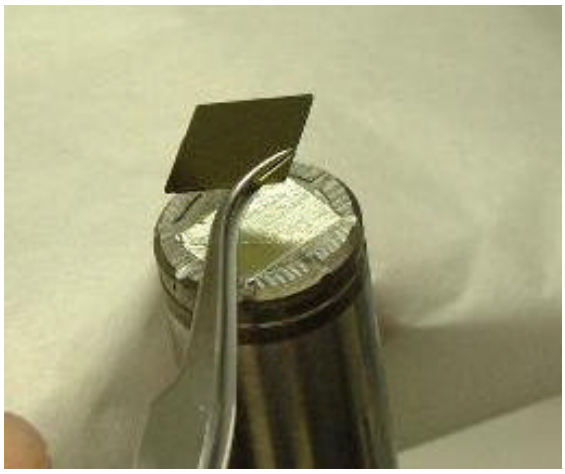
13) Ensure that the surface of the stalk is clean and free of any remnant crystal fragments from the previous photocathode.



14) Cut off a one-inch piece of the Indium ribbon and center it on the end of the stalk.

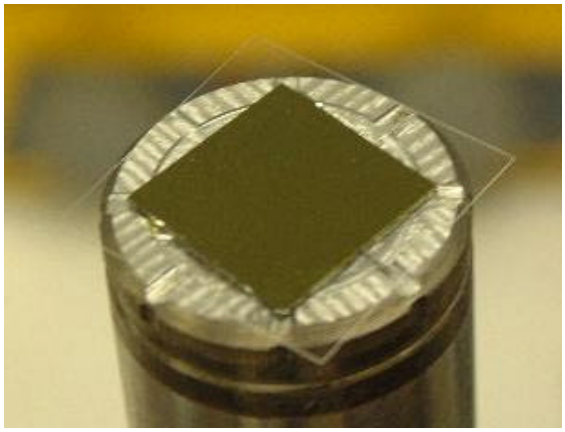
15) Once centered, smooth the Indium onto the stalk pressing out the wrinkles.

16) Center the photocathode, anodized side up, on the stalk. Ensure that the wafer rests fully within the recess. The photcathode should lie flat on the surface and be square as oriented to the square shape of the recess. A wafer that is not properly oriented in the recess may crack when the Tantalum cup is applied.



17) Place a glass cover slide on top of the photocathode careful not to scratch the wafer.

Do not drag the slide across the surface of the wafer.



18) Place a small weight, ~40 grams, onto the glass cover slide. In order to keep from moving the cover slide and the weight across the surface of the wafer balance is important.

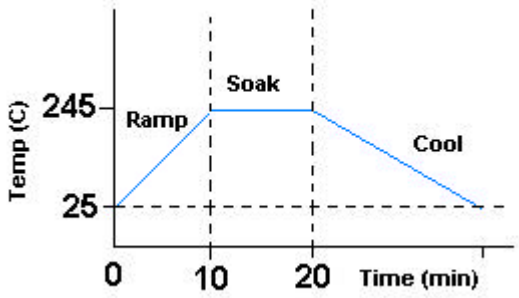
Physical properties of Indium

Melting point	156.6C
Boiling point	2080C

Coefficient of thermal expansion Linear, 24.8µm/m·K at 20 C

19) Program the stalk temperature controller as follows:

a) Ramp from 25^{0}C to 245^{0}C in 10 minutes.
b) Keep the stalk at 245^{0}C for 10 minutes.
c) Turn off heater and allow stalk to cool to room temperature.

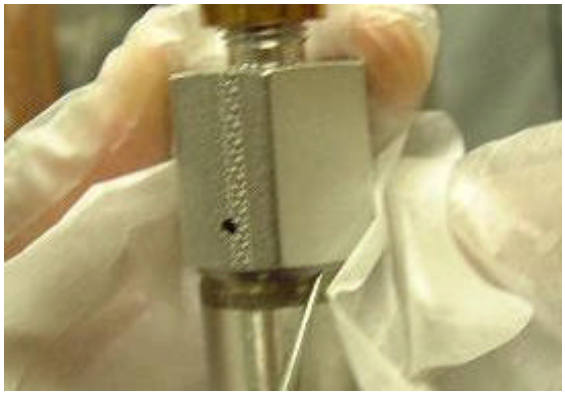


Note: For a Tunnel Cathode, a vacuum vessel surrounds the stalk. The vacuum aids in removing gases, trapped between the wafer, the stalk and the Indium, which are liberated as the items are heated

20) Remove Weight and cover slide.

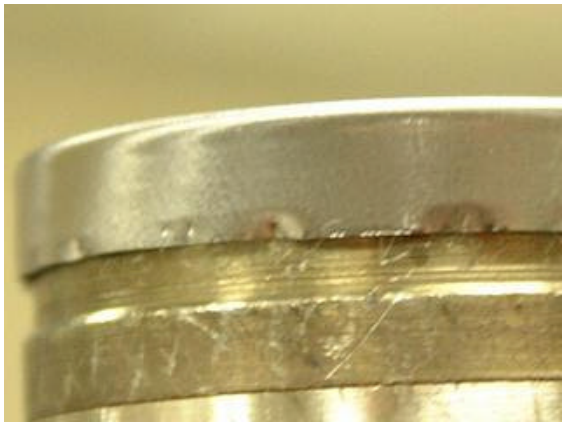
21) Carefully place a Tantalum cup onto the end of the stalk.

22) Place the crimping fixture on top of the tantalum cup, photocathode and stalk.



23) Using the crimping tool, press a small indentation into the tantalum cup, locking it into the groove in the end of the stalk. Remember to lightly press the crimping fixture downward as the tantalum is indented. Too much pressure, unevenly applied, may crack the wafer.

24) While continuing to apply a light pressure, move 1/4 of the way around the cup and crimp again. Repeat until four equally spaced crimps are made.



Note: The downward pressure on the crimping fixture may now be eased, but do not remove the fixture. It will help protect the photocathode if the stylus slips. It will also provide an effective way to support the stalk as pressure is applied to crimp the Tantalum cup.

25) Place a total of twelve indentations, equally spaced about the circumference of the tantalum cup.

26) Inspection of the stalk should reveal a Tantalum cup with a smooth surface; free of raised areas revealing the shape of the photocathode below.

27) After inspection load stalk into a clean stainless steel transfer tube under Nitrogen purge for storage or into the hydrogen chamber for cleaning.